DOCUMENT RESUME

ED 062 553 VT 015 270

AUTHOR	Conroy, William G., Jr.
TITLE	An Integrated State and Local Management and Information System for Occupational Education in Massachusetts. A Monograph.
INSTITUTION	Massachusetts State Dept. of Education, Boston.
PUB DATE	Nov 71
NOTE	84p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Conceptual Schemes; Cost Effectiveness; Decision Making; Educational Accountability; Feedback; *Information Systems; *Management Systems; Program Development; Program Evaluation; State Programs; *Systems Development; *Vocational Education
IDENTIFIERS	Massachusetts

ABSTRACT

To enable vocational educators to evaluate programs and account for the use of allocated resources, this monograph describes a rational decision-making process based on the Input, Process, Product, Impact conceptual structure for occupational education. In a rational management process, all management behavior is consistent with specified objectives and goals, which are modified in light of performance over time. Such a process is dependent upon a continuous flow of information which describes the goals and objectives of occupational education, the degree to which they are accomplished, and the elements which contribute to their accomplishment, all available in terms of cost, forming a foundation for accountability. The Management Information System for Occupational Education in Massachusetts is described in the document as it relates to the proposed system. (JS)

ED 062553

A MONOGRAPH

AN INTEGRATED STATE AND LOCAL MANAGEMENT AND INFORMATION SYSTEM FOR OCCUPATIONAL EDUCATION IN MASSACHUSETTS

by
William G. Conroy, Jr.
Division of Occupational Education
Massachusetts Department of Education
Boston, Massachusetts

November, 1971

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PREFACE

Two consultants have played an important role in developing this monograph. Jacob J. Kaufman, Professor of Economics, Pennsylvania State University, is responsible for all aspects of this document which deal with economic analysis. Further, Mr. Kaufman has influenced the style and logic of the entire publication. Jimmie C. Fortune, Professor of Research, University of Massachusetts, made vital contributions to the section of the monograph which describes the nature of the information system. Mr. Fortune's insightfulness in the area of educational research is reflected throughout this total effort.

Finally, although this monograph is targeted to Occupational Education, the integrated state and local management system developed herein is generalizable to all curricula areas.

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Introduction

Education in America today is in crisis. For different and sometimes conflicting reasons, important groups in American society are dissatisfied with public education. Rightly or wrongly, widespread criticism of American education comes from legislatures, parents, students, teachers, and a variety of influential institutions and organizations. The same educational process which has failed to meet the expectations of a large segment of American society constitutes a substantial part of that society's budget on a state and local level, both on an absolute and relative basis. In fact, as revenues in the state rise there is a tendency for education to automatically absorb a very major part of the increased resource. That education does take such a substantial part of government's budget is creating serious problems, particularly with public opposition to rising taxes and the growing demand on the part of the people for government to meet other needs by offering additional services.

A resolution must be found to the conflict caused by the demand on the part of the public for a broad range of government services and the tendency for education to absorb a large and increasing proportion of the government budget. It should be anticipated that state legislatures and the people of the states will attempt to resolve this conflict by reducing the proportion of money allotted to education. If one combines this conflict with the criticism of the quality of education, it becomes clear that American education must justify its expenditures and strive to provide more and better education for less money.

Even within education there is competition for the limited dollars. Academic education seeks more funds and competes with vocational-technical education. Higher education seeks more funds and competes with secondary education. Within higher education there is competition between universities and junior colleges. Thus, with the limited funds available for education, each sector within education must demonstrate that the use of its funds results in the maximum output in relation to the money made available to it. In other words, each of the sectors of education must become accountable to the public and attempt to demonstrate that its type of education yields results consistent with the goals that society has set for that subsection of education.

In order to develop an appropriate system of accountability for American education it is essential that a rational management process* be instituted and maintained and an information system be developed which will provide information such that management can demonstrate that it is achieving the maximum with the limited resources made available to it. The purpose of this publication is to describe a rational management process for Occupational Education in Massachusetts and to describe the types of information which are essential to support such a management process. It should be recognized that a management information system is an essential ingredient of all management processes. However, the scope and quality of the management information system defines the extent to which management can be rational, efficient and accountable.

Chapter One stipulates a conceptual structure for Occupational Education, while Chapter Two describes a rational management process for Occupational Education which is consistent with the conceptual structure

* A rational management process is defined as one in which all management behavior is demonstratively related to the attainment of specified goals.

offered in Chapter One. Chapters Three and Four present the structure and nature of a Management Information System for Occupational Education in Massachusetts which is a function of the conceptual structure and rational management process for Occupational Education described in Chapters One and Two. Chapter Five examines several constraints society places on a rational management process and some of the necessary conditions required to develop a supportive Management Information System for Occupational Education as described in this publication.

Chapter One

A Conceptual Structure for Occupational Education in Massachusetts

Occupational Education in Massachusetts is a large and complex enterprise which is managed by federal, state and local government. For example, in fiscal year 1970 about 113,000 students were enrolled in Occupational Education in Massachusetts at an operating cost of over $100,000,000. Millions of dollars of buildings and equipment, thousands of teachers and administrators and a wide range of instructional materials and strategies are all part of Occupational Education in Massachusetts. All of these individual elements are continuously changing as a result of interacting with each other and the society they serve.

If management of Occupational Education is to act rationally, i.e. if management behavior is always related to specified goal attainment, a reasonable and useful structure must be provided for classifying the diverse range of elements within Occupational Education. Such a structure must be reasonable in that it is logically related to the reality and tradition of Occupational Education and useful in that it offers a management tool that is consistent with information needs which enable management to determine the degree to which it is attaining its goals.

The Conceptual Structure

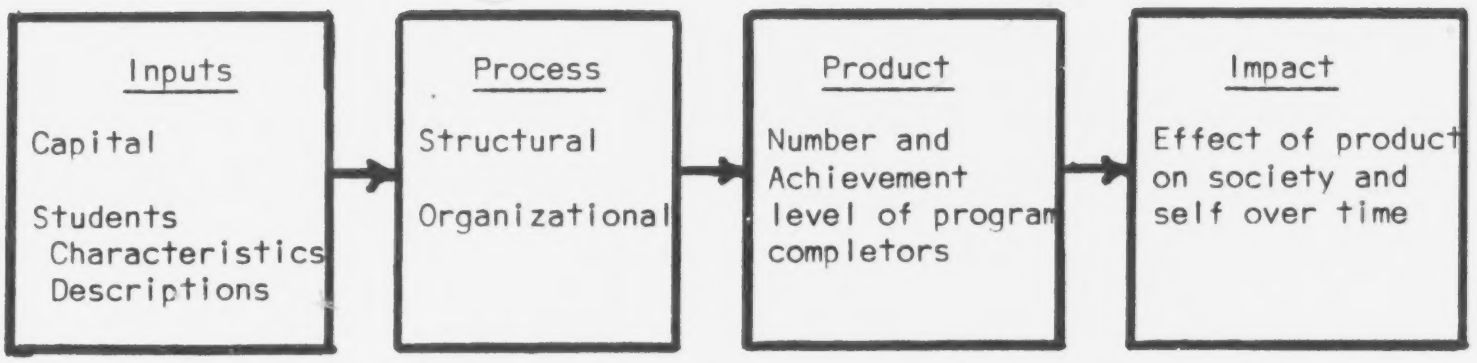
A conceptual structure is nothing more than a plan for describing and classifying the parts of a whole and the relationships among those parts. Typically, such structures are a compromise between the complexity

of the whole and the capabilities of the user. Occupational Education is a complex whole, managed by a wide range of individuals, from the United States Congress to students, with teachers, and state/local elected officials and appointed administrators wedged in between. These givens dictate a conceptual structure which is both comprehensive and uncomplicated.

The four boxes in Figure I are offered as a visual description of the conceptual structure of Occupational Education for both the rational management process and information system developed by this publication.

Figure I

A Conceptual Structure for Occupational Education



The conceptual structure presented in Figure I describes Occupational Education as a four-element whole in which students and capital experience a planned process, resulting in product which can be described by the knowledge, skills and attitudes of students completing the planned Occupational Education process. The impact element of the conceptual structure defines the degree to which the product or the behavior pattern of graduates affect society and the life style of the program completor during the life time of the student.

Of course the instructional programs vary both within and among communities; various types of students react or interact differently to similar programs; successful program completors can vary quite widely in terms of end program achievement, i.e. knowledge, skills and attitudes, and students with similarly described achievement levels at program completion can display a differential impact on society and self over time because of different intervening experiences. As the educational research community might put it, interaction can explain variance. For example, it might be that the interaction of the right student (perhaps one who feels he can and wants to learn) with the right teacher (maybe an empathic, knowledgeable, authoritative human being) with the right teaching style (say coaching the student to "discover" how something works) within a supportive environment (which could be a well-equipped, non-oppressive school setting) at the right time (both teacher and pupil are well-prepared and rested) could produce a desirable result. Changing any of these elements could change the interaction among the elements and significantly affect outcomes. Unfortunately, things are just not simple.

The complexity of Occupational Education is emphasized at this time to signal to the so-called research community that the conceptual structure for the management and description of Occupational Education is not conceived in ignorance. Although the structure does represent a compromise between the complexity of reality and the needs and capabilities of the wide range of managers, it is sufficiently flexible to accommodate the interactive relationships which characterize Occupational Education.

The following is a description in some detail of each of the four elements of the conceptual structure for the management and description of Occupational Education. An understanding of these elements is basic to dealing with the balance of the publication.

INPUTS - Inputs are conceived of as the raw materials for Occupational Education and restricted to capital (money or dollars) and student descriptions and characteristics. Monetary resources can come from a variety of sources, while student characteristics can range from personality variables to physical characteristics. Inputs are not conceived as a "given" but determined by management.

Frequently, models to describe educational systems include a separate element which is designed to reflect the context of the nonschool world of the student. This conceptual structure does not, and includes all such information as student characteristics or descriptions. Student characteristics such as abilities, self-concepts, attitudes, and the like, are, in part, a function of the interaction of the student within his special environment as he experiences it. Descriptions of this environmemt are included within the impact element. These might include such things as size and socioeconomic status of family, educational level of parents, attitudes of parents toward dependence of student on family, etc.

PROCESS*- The process element of the conceptual structure for Occupational Education includes all the planned parts of the instructional program. The instructional program is categorized as either structural or organizational.

* The description of this element is purposefully related to some earlier work of David Berliner.

A. Structural Variables - The intent of defining a category of the instructional program called structural variables is to describe those aspects of the formalized learning process which are either invariant or at least hard enough to change so that they appear invariant. Thus, we are distinguishing between the more static aspects of an educational system and the more dynamic aspects. In the latter case, we could be discussing organizational considerations. The organizational aspects of a system are more fluid and subject to change than are the structural aspects, which more nearly represent the "givens" of the situation, thus making this the hardest to change aspect of the system. Structural variables include: buildings; their size; student capacity; age; the dollar value of the plant, etc. Under this category, information about the available equipment might include: number of pieces of equipment of a specialized type, i.e. V 8 engines, lathes, and oscilloscopes; dollar value of equipment; age of equipment, etc. One can include in this category information on the socioeconomic and demographic characteristics with which a school must concern itself, for example: the neighborhood within which the school lies, i.e. whether the vocational training is occurring within an industrial community, or whether vocational education is occurring within a rural or suburban community. The indebtedness of the district, the tax rate for schooling and per pupil expenditures for vocational and academic programs might be used as indices of the district's commitment to

educational quality. Other structural variables could include: teachers' salaries, teachers' degree status or teachers' experiences.

The category of structural variables is intended to aid the reader in conceptualizing those difficult to change, or invariant aspects of Occupational Education. No attempt is made to be exhaustive. "Hard to change" variables which may influence the student have been illustrated and these variables seem to be grouped logically under the heading called structural variables.

B. Organizational Variables - Under the category of organizational variables within the process element are those aspects of the planned instructional program which are fluid and subject to much more change than the variables described as structural. For example, the size of the class; the number of periods per day; whether the school is using an open-lab or close-lab concept, etc. All of the above are conscious decisions which describe the way learning should be organized and, therefore, are subject to change. The totality of these organizational considerations represents at any one time the belief system of management concerning the best way to organize the learning process. Under the heading of organizational variables, one can include such things as: number of vocational-technical advisory groups; size of those groups; pupil/teacher ratio; teacher/administrator ratio; the number of electives allowed;

the schedule or way in which time is organized: homogeneous or heterogenous groupings of students; discipline regulations; admission and dismissal standards; school decision-making process; student self-government considerations, etc.

The point in specifying organizational variables is to be able to list those aspects of the planned learning process which, through vote or tradition, have led to certain educational practices designed to attain specified goals.

PRODUCT - The product dimension of the conceptual structure for Occupational Education is described as the specific competencies or capabilities which students attain as a result of participation in a specific Occupational Education program. (Also included is the number of program completors in the product dimension). These capabilities might be cognitive or deal with knowledge acquisition or application, psychomotor, described as knowledge application requiring major physical manipulation, or affective, which includes learned values or feelings toward specific persons, objects or ideas. The product dimension is described by what the student can or will do at the end of a planned learning experience. In other words, the product dimension describes the achievement level of the student as he rolls off the educational assembly line. The product of an educational program may be expected or unexpected, desirable or undesirable, but always limited to end program capabilities of a planned educational experience as it differentially interacts with the students it serves.

IMPACT - The impact dimension of the conceptual structure is a result of the performance of the educational product or program completor after graduation, i.e. the impact of the product of the educational process on society and on self, over time. Impact might be described by such elements as: earnings, employment pattern, job satisfaction, voting behavior, citizenship behavior, occupational mobility, self-concept as a human being, etc.

Summary

The Input, Process, Product, Impact (IPPI) conceptual structure for Occupational Education provides the basis for the development of the rational management process and information system offered in this publication. It is purposefully designed to provide a mechanism for relating information describing Occupational Education to a management process such that managers can be more rational, efficient* and accountable in developing and maintaining Occupational Education in Massachusetts. Such a systematic conception seems a necessary minimum management standard in face of the scope and social consequence of Occupational Education.

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* Efficiency is defined as achieving the most with a given amount of resources or achieving a given amount with the least amount of resources.

Chapter Two

The Nature of the Management Process in Occupational Education

The management process for Occupational Education in Massachusetts is as complex as is its structure.* Any attempt to simplify the management hierarchy would constitute a misrepresentation of reality. The complexity of the management hierarchy of Occupational Education will be detailed in this chapter. Prior to that, however, a rational process for managing Occupational Education without respect to the complex management hierarchy will be described. This rational management process is based upon the conceptual structure for Occupational Education developed in Chapter One. Further, the Management Information System for Occupational Education which is offered in this publication is dependent upon the implementation and maintenance of the rational management process described in this chapter. The Management Information System for Occupational Education is keyed to both the rational management process stipulated in this chapter and the conceptual structure described in Chapter One.

Management as Decision-Making

Essentially, management can be explained as decision-making. Decision-making can be described as a choice process, in which an individual or group of individuals decides to implement a particular alternative. Those responsible for implementing an alternative are predicting that it is the most likely of all alternatives to accomplish a particular goal or set of goals. Frequently or occasionally there is evidence which describes the probability that a particular alternative

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* The management process and related information system developed in this document concern themselves with only state and local government levels. Federal laws and guidelines are defined as "givens".

will contribute to the achievement of a specified goal. A decision point is described as the implementation of an alternative while the decision-making process involves the consideration of alternatives for goal accomplishment.

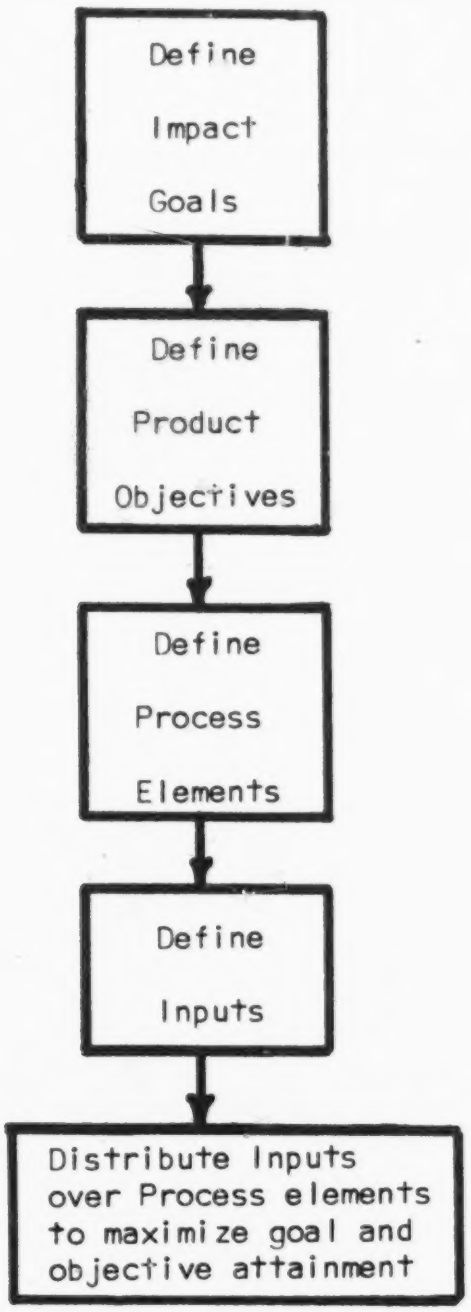
A Rational Management Process

Two kinds of decisions in Occupational Education are stipulated: definitional decisions and distributive decisions. Definitional decisions are those which define the components or parts of each element of the conceptual structure for Occupational Education developed in Chapter One. Distributive decisions allocate the resources of capital and students to specific process elements or alternatives which have been defined previously by definitional decisions.

Figure 2 displays the sequence of the rational management process for Occupational Education. The sequence specified in Figure 2 is important. First impact goals are specified. Product objectives are then developed which flow from and are related to the specified impact goals. Process elements, both structural and organizational, are established to attain product objectives and ultimately impact goals. Capital is then allocated to support the educational program and specific groups of students are enrolled. Finally, distributive decisions determine levels of support for various elements within the instructional program and the number and type of students to be assigned to elements or phases of the learning process.

Figure 2

The Rational Management Process Flow



Note: At this point in the development of the monograph, no provision is made for feedback of experiences into the decision-making process. This is the purpose of the information system. See Figure 5, page 58.

A rational management process assumes that educational processes and inputs are defined and inputs are distributed over process elements such that there is a straight-line relationship between these determinations and impact goals as well as product objectives. The information system which will be discussed in the following two chapters is designed to describe the relationships between inputs and process in terms of objective and goal attainment such that knowledge is developed about the probability of success for a chosen alternative to accomplish a specific goal. The rational management process by definition also includes an examination of the appropriateness of goals and objectives in light of information describing relationships between inputs, process, product and impact elements.

At this point it should become fairly obvious that the purpose of the Management Information System for Occupational Education is to improve the decision-making process. This deceptively simple statement conceives of management on the broadest possible basis and includes citizens, legislatures, administrators, teachers, parents and students. The relationship between these groups and the management process for Occupational Education will be discussed below. However, it is important to note at this point that the Management Information System for Occupational Education is practically worthless unless Occupational Education is managed rationally. This is to say that the rational management process herein stipulated is a necessary first step to the development of an information system for educational management. Further, definitional and distributive decisions for Occupational Education on all levels must be reviewed and modified regularly, in light of performance over time. For the purpose

of this publication regularly means annually. The distinction between short and long term decisions is acknowledged although not developed in this publication. Short term decisions typically set standards for one year, while long term decisions deal with longer time frames, usually three, five or ten years.

The following is a simplified example of the rational management process in Occupational Education stipulated in this publication.

Definitional Decisions

Simply put, these decisions define the IPPI elements. First, Occupational Education managers stipulate impact goals which are measurable. These goals describe the desired impact of the product or graduate of Occupational Education on society over time. An impact goal might be that eighty percent of the graduates of a vocational program should be employed in the field for which they are trained during their first year of becoming available for placement upon graduation. A further impact goal might specify that Occupational Education graduates will progress to a leadership position within a training-related occupation within a specified amount of time upon graduation.

Other impact goals might specify that the product of Occupational Education should be satisfied as workers in their employment, active citizens and fulfilled human beings. An impact goal might name broad occupational fields for which students are to be prepared. Typically, impact goals are established at higher levels, and reflect the value orientation of the society served by education.

Given impact goals, product objectives are stipulated which describe the kinds of capabilities by occupational program which should be attained by program completors. Further, the number of graduates sought by a particular occupational program area is stipulated. Product objectives are typically determined at lower levels, and usually by the professional educators in concert with advisory groups. Product objectives all have a straight-line relationship to specified impact goals. An example of product objectives would be a listing of specific capabilities or levels of achievement which students must attain within a particular occupational field. In fact, occupational fields can be defined by a prescribed list of specific capabilities. In other words, product objectives describe the specific behavior an instructional program seeks its students to attain. All product objectives are measurable, i.e. it is possible to determine the degree to which a student can achieve the specific objective. Further, when a student becomes an educational product, i.e. a program completor, he is or can be described by a record of his behavior on stated product objectives. Such a description can vary from a general pass/fail statement, i.e. he passed the auto mechanics program, to a detailed description of cognitive, psychomotor and affective capabilities.

Given the specification of impact goals and product objectives, educational management determines the process elements which are designed to attain these specified goals. As described above, these process variables include structural and organizational variables. Process elements range from the types of equipment to the amount of time students are allowed to use equipment. They include all instructional strategies, instructor's qualifications, descriptions of student and faculty relations,

etc. A rational management process assumes that there is a straight-line relationship between each definable process element and a stated product objective. There is no other justification for the maintenance of a process element in a rational management process.

Finally, definitional decisions are made which define the numbers and kinds of students to be served and the amount of money available to accomplish the goals specified by impact and product decisions. For example, educational managers might decide that the students who should have first call on Occupational Education are those who are most likely not going to attend further education. Other stipulations within this sub-category might tend to describe those students who are most likely to benefit from an Occupational Education experience. Of course, special target groups can be stipulated within or beyond these categories. The definition of capital inputs is achieved by stipulating the resources available for Occupational Education. These resources typically begin as dollars but are then translated into goods or services.

Distributive Decisions

After the definitional decisions have been made, educational managers make distributive or resource allocation decisions, in which students and resources are assigned to specific program elements. For example, an input decision might be that twenty percent of a student body should be socioeconomically disadvantaged Black youth, while a distributive decision could be that these youth should be equally distributed over a specified range of Occupational Education programs. Distributive decisions also determine the level of funding to support specific instructional programs

or elements thereof. For example, a distributive decision would be that a fixed percentage of capital should be allocated to purchase a specific range of equipment for a particular Occupational Education program.

The Management Information System for Occupational Education developed in this publication is designed to feed back to the educational manager an estimation of the degree to which impact goals and product objectives are attained as well as information which describes the relationships between process elements and goal or objective achievement in terms of so-called inputs. Such information is designed to improve the odds for managers in selecting "the most likely to succeed" alternative to accomplish most efficiently a specific goal for a particular group of students.

The IPPI based, rational management process described in this chapter must be maintained by all the managers of Occupational Education at all levels if the information system is to be useful at all levels. To appreciate fully the overwhelming implications of this assertation, it is necessary to examine the following section.

The Management Hierarchy for Occupational Education in Massachusetts

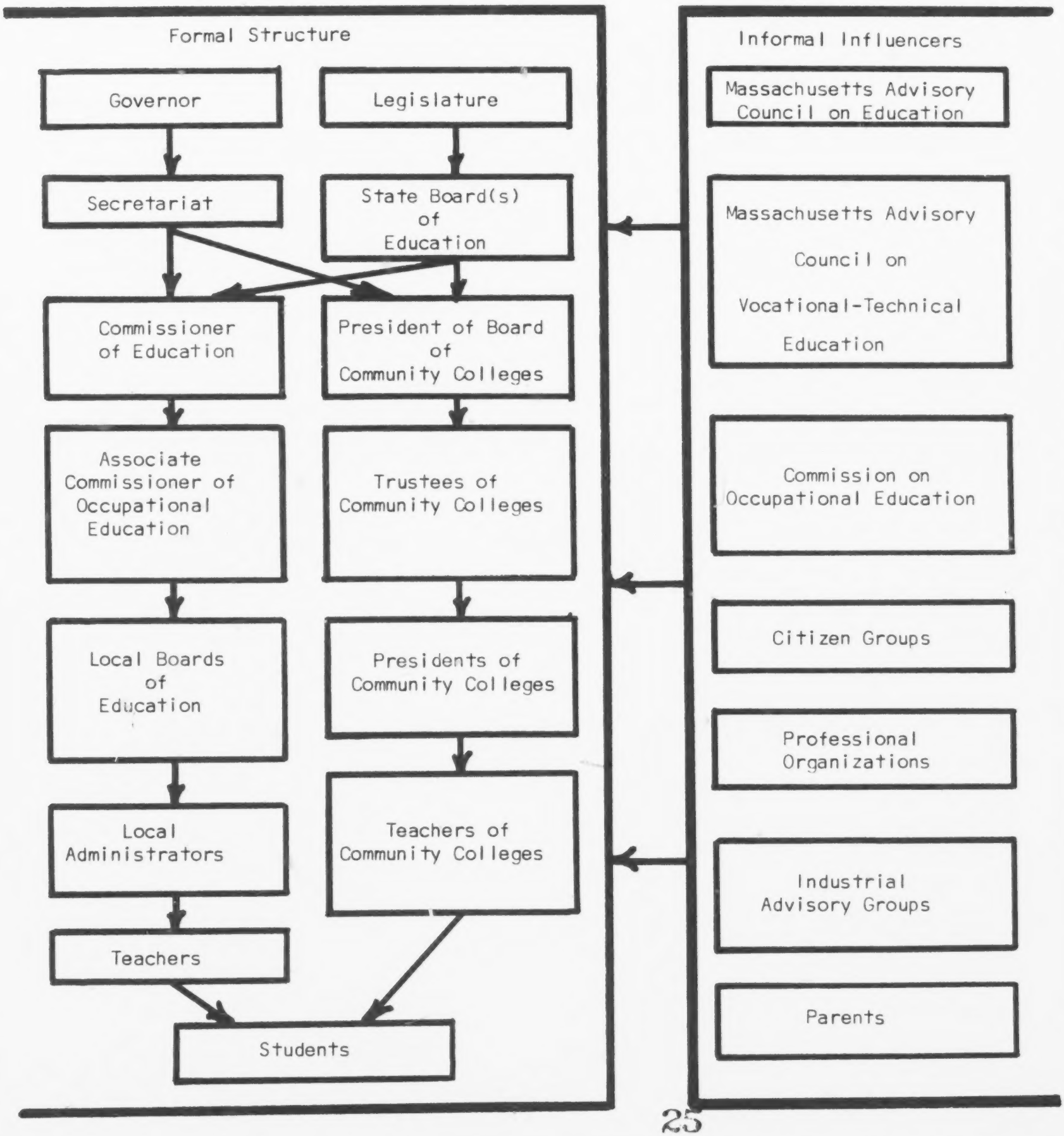
Classically, education is defined as a state function. However, state legislatures have delegated much of their decision-making authority to officers on the local level, i.e. local school board members. In addition, Occupational Education in contrast to academic education is unique in that it has had a long relationship working with federal guidelines and regulations. As a matter of fact, the federal government has cut its teeth in educational management with Occupational Education.

However, as previously described, federal rules and regulations are conceived as givens or constraints in the rational management process and related information system developed by this publication.

Figure 3 presents a fairly simplified picture of the management hierarchy for Occupational Education in Massachusetts.

Figure 3

MANAGEMENT HIERARCHY FOR OCCUPATIONAL EDUCATION IN MASSACHUSETTS



A first reaction to the management hierarchy for Occupational Education in Massachusetts is that it presents a hopeless morass for a rational management process. In fact, there are armies of professionals and citizens who have historically held that management concepts of efficiency, rationality, and accountability challenge the very democratic principles of American education. What is attempted in this publication is to develop a rational management process for Occupational Education which allows it to operate efficiently and provides a knowledge base or empirical foundation for accountability, but which does not threaten the traditionally democratic principles of American education. One must at least consider the possibility that even in education patriotism might be the last resort of professional scoundrelism.

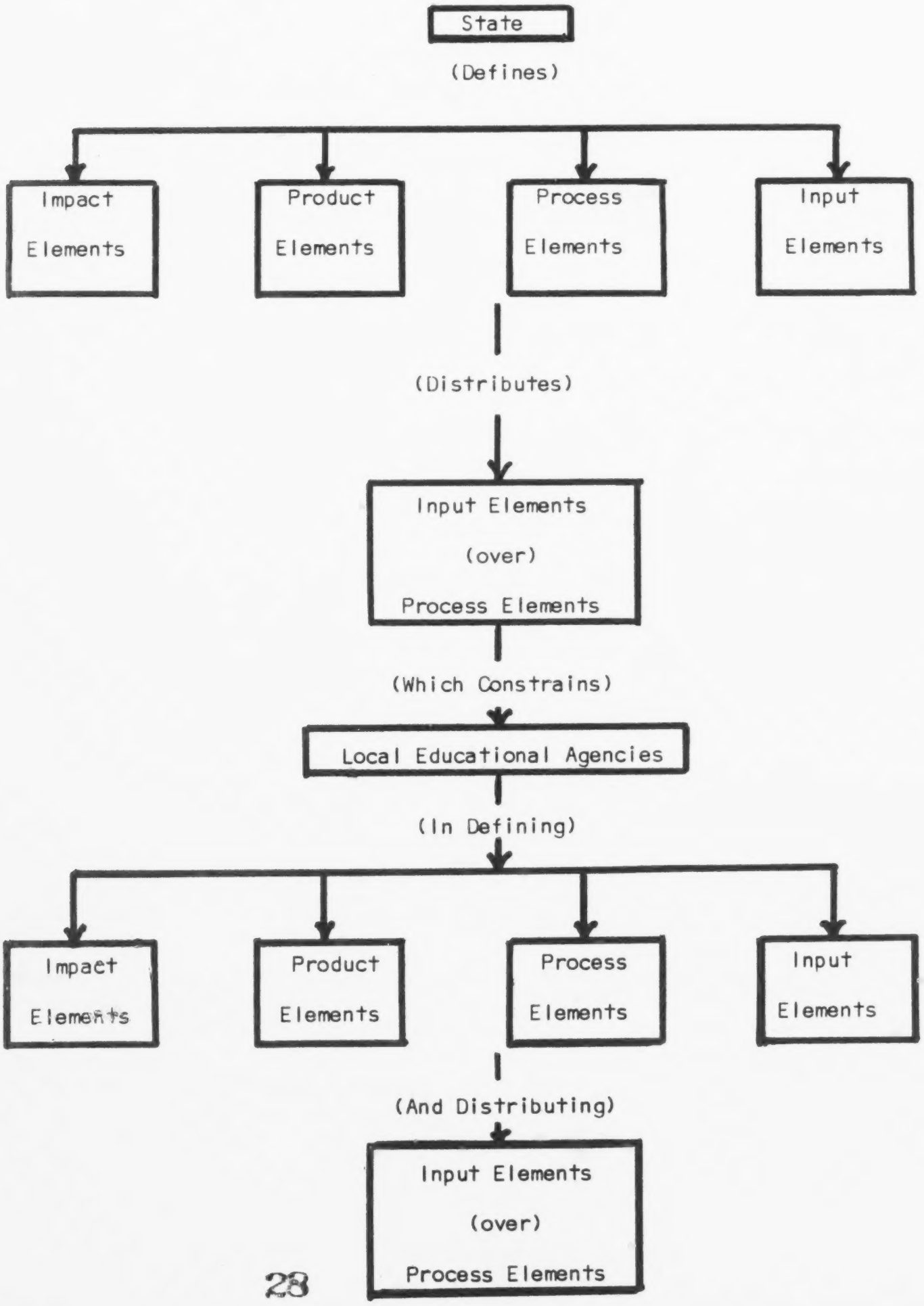
Role incumbents at all levels of the management hierarchy for Occupational Education make significant decisions for Occupational Education. Frequently, there are not clear cut lines of authority marking off the range of responsibilities among levels on the management hierarchy. Typically what occurs is that role incumbents on all levels tend to make decisions for all elements within the conceptual structure of Occupational Education, with decisions on higher levels placing constraints on decisions made at lower levels. For example, a minimum standard in terms of attendance time (a structural process element) is established at the state level by the legislature and enforced through the State Department of Education. Management decisions made by local boards of education, local school administrators, school department heads, teachers and students

in respect to attendance time must occur within the State established time constraint. These higher level process-definitional-decisions might determine the number of school days per year, the length of time for each school day, or the amount of time a student must spend pursuing a particular course of study, etc. Other constraints to decision-makers on the lower level of the management hierarchy which represent prior decisions of role incumbents on higher levels could include: building standards, qualifications for instructors, approved textbooks, equipment specifications, teaching strategies, etc.

Figure 4 presents a picture of the operation of the decision-making process by the management hierarchy for Occupational Education in terms of the IPPI conceptual structure for Occupational Education presented in Chapter One of this publication.

Figure 4

The Hierarchical Decision-Making Process for Occupational Education



As Occupational Education is currently practiced, significant decisions are made by all groups on the management hierarchy. Students decide which programs to elect, teachers determine what materials to use and what teaching strategies to employ, department heads specify specific dimensions of individual Occupational Education programs, local educational administrators define the organizational structure used to support the institution's role, local school boards play an important role in financing the educational program, the State Department of Education carries out the definitional and distributive decisions of the state legislature and the State Boards of Education, while the informal influencers typically establish a frame of reference and sometimes a level of expectation for the role incumbents of the management hierarchy.

Summary

A rational management process defined as one in which all management behavior is consistent with specified objectives and goals and in which objectives and goals are modified in light of performance over time has been developed. Further, educational management has been described as a definitional and/or distributive decision-making process. The rational management process has been examined in the light of the complex management hierarchy of Occupational Education. It is assumed that the dependency of a rational management process for Occupational Education in Massachusetts on the IPPI conceptual structure for Occupational Education offered in Chapter One is axiomatic by this time.

It was stated that a purpose of a rational management process was

efficiency, that is achieving the most with a given amount of resources or achieving a given goal with the least amount of resources. Frequently, such a statement yields a negative response because a suspicion is that the hidden reality is a desire on someone's part to hold the line on a drastically reduced budget. Efficiency as it is defined in this publication is conceived as a positive term. An efficient management process assumes that all the goals are in fact stated and there is a regular process of determining the degree to which these objectives and goals are achieved and at what cost. Further, it assumes that there is a way of describing the relationship between elements of the educational program and educational outcomes which can be defined in terms of dollars. This implies that the relationships among input, process, and product elements can be defined in the first place. Unless educational managers have access to such information on a regular basis they simply cannot behave in a rational way. This is to say that a rational management process for Occupational Education is dependent upon a continuous flow of information which describes the goals and objectives of Occupational Education, the degree to which they are accomplished and the elements which contribute to the accomplishment of the stated objectives. All this information must be available in terms of cost. Such information obviously forms a foundation for accountability. The balance of this publication describes the Management Information System for Occupational Education in Massachusetts which is a function of and designed to be supportive to the rational management process stipulated in this chapter and consistent with the IPPI structure for Occupational Education outlined in Chapter One.

Chapter Three

The Structure of the Management Information System for Occupational Education

Although the information system described in Chapters Three and Four is difficult to develop and implement, it is essential to the maintenance of a rational process for managing Occupational Education in Massachusetts. It must be fully understood if rational management is to be established in Massachusetts.

Basically, this chapter contains a listing and description of the various types of information of the Management Information System for Occupational Education. Each type of information is directly related to the IPPI conceptual structure of Occupational Education described in Chapter One. The purpose of the information system is simply to describe the elements within the conceptual structure of Occupational Education and the relationships between these elements in such a way that they are supportive of a rational and efficient management process. It is no more complicated than that.

In this chapter each information type will be described with a minimum of detail. Further, the necessary steps required to attain such information will be suggested. Information attainment requirements will be referenced by a concern for existing levels of information in Massachusetts at this writing.* Much of the information described can be obtained on

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* A publication describing the educational information available at the Department of Education and at the local educational level is described in a publication of the Massachusetts Department of Education.

Downey, Gerald F. (Lowell Technological Institute) Survey of Information Status of Occupational Education in the Commonwealth of Massachusetts - A report submitted to the Massachusetts Research Coordinating Unit, June 1971.

a sampling basis, although a discussion of sampling procedures is beyond the scope of this publication.

Two types of information within the Massachusetts Information System for Occupational Education are hereby stipulated: descriptive information and analytical information. Descriptive information describes each of the IPPI structural elements for Occupational Education, while analytical information describes the relationships among the IPPI structural elements for Occupational Education. If the information system is to be supportive of a rational management process for Occupational Education, it must be equally useful at all levels of the management decision-making hierarchy in Massachusetts. This problem will be dealt with in Chapter Four, but it is acknowledged at this point to alert the reader to a need to analyze the following in view of this requirement.

Descriptive Information

The following section presents the four descriptive information types of the information system:

Input Information - Input information describes the number and types of students served by Occupational Education and Cost Information. Such information includes student characteristics and descriptive information.

Student Characteristics and Descriptive Information - Student characteristics and descriptive information include a description of students' aptitudes, attitudes, personality factors, age, sex and other useful data which describe the range of human beings

who are enrolled in Occupational Education. This also describes relevant conditions which are likely to influence the student; for example, socioeconomic status of the family, attained educational level of the parents, number of brothers and sisters, etc. Since it can be assumed that educational programs differentially affect different kinds of students, the accurate recording of this information is absolutely essential to the development of information which will allow management to improve the probability of predicting outcomes from management decisions.

Cost Information - Costs will be dealt with within several information types of this chapter. However, costs can be considered the resources required to support the educational program. There are, however, certain cost concepts that should be clearly understood: Costs are frequently described as "alternative costs" or "opportunity costs". In effect, they are "benefits lost". For example, the cost of a pair of shoes is two shirts; the cost of offering a vocational program in vocational agriculture is the offering of a vocational program in cosmetology; the cost of increasing teachers' salaries is decreasing the number of teachers' aides. But how does one estimate these costs? There are essentially four ways: (a) the resources required in terms of manpower and materials; (b) the alternative uses of these resources; (c) the value of these alternatives; (d) the dollar expenditures. Actually, consideration should be given to all of these four ways of estimating costs.

Consideration must also be given to the distinction between past costs and future costs. There are certain costs which have been incurred reflecting past decisions. For example, once a school has been built, the costs are past or sunk or fixed. Such costs should no longer enter into the making of current decisions. Current decisions are made on the basis of future or incremental costs. For example, once a school building has been constructed, the decision to hire teachers, purchase machinery, or purchase supplies represents future or incremental costs. Again, once teachers have been hired, or machinery and supplies purchased, these costs become fixed. An increase in enrollment in vocational education, requiring the purchase of additional supplies, then becomes a future or incremental cost. In effect, all cost decisions at a given moment of time are incremental, or added, or marginal-- these terms are interchangeable.

A third distinction must be made between costs which are internal to the organization and those which are external. For example, the costs of machinery or the employment of personnel are internal costs. The discharge of waste materials into a stream which pollutes the stream from which others must draw upon are external costs.

Process Information - Process information includes a documentation of the process variables, structural and organizational, which describe the varied educational programs as they exist within the Commonwealth.

Process data ranges from a description of the types of teaching strategies employed to the ages of school buildings. It includes all of the relevant aspects of the formal learning process. Obviously, this information is absolutely essential. Unless educational managers can differentiate among the various aspects of the formal educational process in a systematic way, it is not possible to determine which program elements are related to objective or goal attainment.

Product Information - Product information describes the degree to which students of Occupational Education have attained the product objectives of occupational programs. Both the specification of product objectives and product information are extremely sensitive areas in the development of a rational management process and related information system for Occupational Education. If education is to be responsive to a variety of simultaneously occurring needs within a society as complex as a state, the information system must be able to accommodate multistandards simultaneously and provide product information within this setting.

Impact Information - Impact information simply describes the impact of the educational product on society and on the individual over time. Impact can be estimated by monetary and nonmonetary measures. Monetary measures deal with those elements that can be logically classified by dollars, for example, earnings. Nonmonetary impact information includes self-satisfaction, voting behavior, positive self-regard, etc. Impact information is sometimes described as benefits. Impact goals are as essential as product objectives to maintaining the traditional democratic

structure of Occupational Education. That is to say, the management process and information system must support different impact and product goals and objectives concurrently if it is not to alter the very foundations of American education.

Impact information is usually gathered on a time-series basis, i.e. at regular intervals after program completion - one year, five years, ten years, etc.

A brief exploration of relationships between product and impact information might be useful at this time. The attainment of an impact goal is not only a function of the educational product, but also of intervening experiences between graduation and the time the impact measure is taken. It is difficult to determine what part of the impact behavior is a result of the educational program and what part is caused by intervening experiences. It is therefore difficult for educational managers to modify Occupational Education programs in an attempt to make them better or more efficient from impact data alone. For program modification the educational manager needs to know the elements of the instructional program that caused the desired impact behavior. It is at this point that product objectives become important. If the educational manager has information which suggests that successful graduates tend to be proficient with a specific set of skills, then these skills become product objectives of the instructional program. For example, quickly and accurately being able to diagnose a number of automobile engine malfunctions by ear might differentiate between successful and unsuccessful auto mechanics in the field. The educational manager can begin to evolve objectives which

describe automobile diagnostic behaviors, measure the degree to which students can attain these objectives, and modify the instructional program to maximize the achievement of this goal. Impact objectives tend to validate product objectives and all product objectives should be related to impact objectives. However, the product objective provides the feedback point for program improvement to the Occupational Education manager.

Existing Descriptive Information

There really is no more to the descriptive information of the Massachusetts Information System for Occupational Education than herein stipulated. A word is in order, however, about the state of this information as it currently exists in Massachusetts. A detailed study of this information is available on request and has been previously footnoted. Cost information in terms of dollars spent annually by community and dispersed by the state is available. However, this information is very gross in that it does not describe the cost of education by program. What is required, of course, is to describe educational programs in terms of cost by specific impact goal and program objective.

There is no information describing student characteristics on the state level, and such information which exists on the local level is uneven. Process information is equally gross, collected on a census basis and typically deals with easy to describe elements like age of teacher, number of years of teaching experience, etc. Product data for Occupational Education, however, are currently being developed. The Evaluation Service Center for Occupational Education* (ESCOE) is a two-state experimental project which is implementing a product evaluation process

* Conroy, William G., Jr. and Cohen, Louis A. The Massachusetts and New York Evaluation Service Center for Occupational Education, A Planning Document, Albany, N. Y. 1970

such that multi-standards or objectives can be simultaneously entertained by a variety of local educational agencies and these agencies can annually receive back information about the degree to which students attain locally developed objectives. Normative data comparing schools offering similar objectives are also available. ESCOE is currently operational in four curricula areas within Occupational Education, and plans to be operational with sixteen program areas for Occupational Education by June of 1972.

Current impact information is limited to data of very questionable validity which describes what program completors in Occupational Education are doing five months after graduation.

Analytical Information

Analytical information is considerably more complex than descriptive information. However, it represents the very core of the information system in terms of its objectives, i.e. to support a rational decision-making process. Clearly, to be able to use this information the educational manager must possess certain minimal skills in the areas of statistics, research design and economic analysis. Unless the educational manager has these skills he is unable to effectively use the information developed by the information system. By definition, if he is unable to use the information he is not able to manage rationally. The conclusion is that if educational managers are unable to understand and use analytical information of the Massachusetts Information System for Occupational Education, a program must be developed to equip managers with the necessary skills. A distinction might be made between professional and lay management. It would seem reasonable to assume that it is the

responsibility of professional management to be able to deal with analytical data or information and to interpret this information to lay management.

Cost and Pupil Accounting Information - This information describes the distribution of dollars and pupils over process variables. It presents the numbers and types of students involved in Occupational Education, and the resources available to support this effort. Within this category are included the specification of the allocation of dollars and students by educational program and subelements within a program for specific product objectives and impact goals. For example, cost-pupil accounting information would indicate that so many students were pursuing objective X_1 within program Y_2 with process elements 1, 2, 3 at a specified cost. Such information allows for a detailed analysis of relationships among programs, and is fundamental to analyzing relationships among outcomes, inputs and processes.

Process-Product Information - Process-product information attempts to detect relationships between a student's educational experiences and his skills or capabilities upon graduation. Thus far product has been discussed as if it were uniform but, in fact, there are excellent, fair, and poor students in an educational system. There are products whose skills are above average, average and below average. There are products who possess varying capabilities over different program objectives. Process-product information describes the relationship between product behaviors and certain antecedent process conditions of the educational process. The relationship between product and process must account for

the variation of input variables, i.e. the difference among students prior to their entrance into the program.

Process-product information usually takes the form of correlational information, i.e. the specification of the relationship between phenomena. Correlation is not causation, and the next level of analysis typically involves control. However, multiple regression analysis provides a useful tool for looking at relationships between process and product. This information is obviously vital to rational management for education.

Cost-Product Information - If product is described as the change in behavioral characteristics of students who have completed a particular segment of instruction, then the basic questions are: (1) What are the costs of achieving these changes in the product? (2) What alternative processes and the costs ascribed to them can produce similar changes in the product?

The decision-maker, in effect, is comparing product-process costs among a number of alternatives on the basis of which a judgment is made to utilize that process which achieves the given objectives established at the least cost.

The procedure to be followed would include:

1. Measurement of performance changes in the behavioral objectives for a particular instructional process.

2. Estimation of the costs of the changes.

3. Analysis of the variation in the performance changes in terms of variations in the inputs.

4. Suggested alternative processes which would reduce the variations in the performance changes and an estimation of the alternative (or extra) costs of the alternative processes.
5. Experimentation of alternative processes in order to determine whether or not the alternative process yields positive performance results.
6. Collection of cost data on alternative process.

Over time, the decision-maker has available to him a variety of alternative instructional processes, as well as expected alternative performance outcomes and alternative costs of these processes.

Product-Impact Information - Product-impact data seek to determine or describe relationships between the performance of students in society after graduation and the capabilities with which students left the program. For example, such information might describe that there is no difference in the occupational success pattern of graduates of Occupational Education programs who achieve differentially on occupational program related performance objectives but who are similar on measures of language ability. That is to say, verbal ability is a better predictor of occupational impact than achievement on occupational objectives.

Process-Impact Information - Process-impact information describes the relationships among the various process elements which students experience and the performance of students in society upon graduation. Because of the nature of the information system (See Chapter Four) the data are connected and linked such that product information can be

referenced by both process and impact information, as well as by input information.

Cost-Impact Information - Cost-impact information is particularly important in that it is generally the base upon which decisions are made at higher management levels whether to invest a particular educational alternative as, say, Occupational Education. The impact of the educational product on society can be described as the benefits of education to society. (It is acknowledged that some impacts are not benefits). This information allows managers to look at the relationship between benefits and costs and provides a basis for resource allocation on the very highest level. The analytical information described up to this point has generally been focused on providing an information basis which is chiefly designed to make the educational process more efficient. Cost-impact information, on the other hand, is the basis for determining the very existence of Occupational Education. Therefore, considerable attention is paid to this information type, and the following section analyzes cost-impact information and its implementation in considerable detail. It is the specific purpose of this section to discuss the relationship of impact to costs in terms of (a) its logic and meaning; (b) some of the misconceptions which prevail concerning this method; and (c) the methodological and data collection issues which arise. A distinction between cost impact and cost benefit analysis will be stipulated.

Logic and Meaning of Cost-Impact Analysis

Under a free enterprise economy, most private wants are satisfied through the workings of the market mechanism. Under this system it is assumed that, as a result of consumer choice, goods and services will be

produced to satisfy these private wants and that the limited resources of the economy will be allocated through the operations of the market in a manner which will yield the greatest output with a given amount of resources.

There are, on the other hand, certain needs and wants which are not or cannot be satisfied by the private sector. A second group of wants, described as social wants, are those which "must be satisfied by services that must be consumed in equal amounts by all". These services are such that some people can benefit from them even if they do not pay for them, and there is no reason to think that such persons would make voluntary payments. Governmental expenditures of this type might include expenditures for flood control, defense, sanitation, etc.

A third group of wants which could be provided by the private sector but, for a variety of reasons, are handled by the public sector because society considers them meritorious, may be referred to as "merit" wants. Included in this category are such items as low-cost housing and "free" education. In these instances the wants could be satisfied by the private sector but society apparently thinks that there are certain social benefits which flow from these activities and therefore society assumes the responsibility to satisfy these wants.

It is not the purpose of this section to discuss the pros and cons of whether the government should concern itself with these "merit" wants. But it is the purpose of this section to concern itself with the method by which it can be determined whether the provision of certain social and merit wants by the government is carried on efficiently, consistent with the objectives for which it has assumed the responsibility.

In the private sector of the economy the market place, in general, is the place where these evaluations take place. The inefficient firm may have to go out of business. The firm that does not produce goods and services which satisfy the needs of the consumers may not survive. But what tests for efficiency and survival do we have when the government provides the goods and services?

The only alternative to the market place for the purpose of testing the efficiency of production or the quality of the product is by cost-impact analysis. Such an analysis is nothing more than an attempt to establish the equivalent of a system of market principles for various types of government activities. It might be reasonable to assert that the method of analysis is not fully developed and that the data available are not adequate. Such charges, however, do not negate the necessity to develop appropriate tools and to obtain adequate data and methodology to judge a particular government activity.

The fact is that there is a tendency on the part of some educators to talk simply in terms of the "needs" of education. Their position is simple: the governmental agency should raise whatever funds are necessary to meet these "needs". On the other hand, there are some who assert that there is a fixed sum of money available for educators to spend on education. The fact is that one should not talk about education in terms of cost or needs alone. No cost can be justified without a reference to payoff. The satisfaction of any need cannot be justified without reference to cost.

This means that one cannot discuss the need for, or the impact of, Occupational Education without relating them to costs, nor can one talk about the costs of vocational education without relating them to impact. If private vocational schools survive, it is reasonable to assume that these schools operate at a profit and that the private sector of the economy is willing to pay the price of tuition. It is not unreasonable to assume, further, that the buyers of the education find that it pays off. It can also be assumed that the profit motive will be a sufficient stimulant to the owner of the private vocational school to keep costs as low as possible.

But what controls exist over public education? What incentives are there for the public educator to keep his costs down? What evidence is there that public education is being provided efficiently? What evidence is there that the objectives are being achieved? It is being suggested that these are legitimate questions to ask during a period in our society when there are many demands for the provision of social and merit goods by all levels of government. Even within education there are many demands for different forms of education. This means that decisions must be made as to the allocation of resources among competing educational programs. The only appropriate method for making these decisions is on the basis of a cost-impact analysis.

One aspect of cost-impact analysis which should be stressed is that it is basically a "way of thinking". It tends, first, to force an administrator to think through his goals. This does not mean that the goals are easy to state. Frequently they are expressed too broadly and do not reflect "real" objectives. It is not enough to state that the

schools educate for the so-called "whole man". There must be more specificity. Nor can it be stated that, for example, Occupational Education is designed to place a youngster in a job. Is it a job related to his training? Is it a job solely in terms of an initial placement or are we concerned with the duration of the job? Is it simply the first job or a series of jobs? Is it a job that leads to promotion? Is it a job that is satisfying to the graduate?

Second, cost-impact analysis, as a "way of thinking", tends to force an administrator to concentrate on costs as well as objectives. The point need not be repeated that inputs, process, products, and impact are interrelated and must not be considered separately.

Third, cost-impact analysis, as a "way of thinking", forces an administrator to think in terms of "alternatives", that is, to think in terms of alternative ways of achieving the same objective. To refer to the satisfying of wants in the private sector again, it should be noted that the pressures of competition tend to force an enterprise to seek other and better means of producing a good or a service. Similarly, concentration on alternatives forces the educational administrator to seek other and better means for the education of youth. In this way change and innovation will take place in education. In fact, it is the failure to evaluate educational curricula that leads to stagnation. It is only through constant evaluation that innovation occurs.

The above comments are designed to indicate in a constructive manner the logic and meaning of cost-impact analysis. Despite what appears to be a rather logical case for this type of analysis there is

still considerable opposition to the technique. Such opposition reflects misconceptions about the method, including a fear that any analysis is a threat to education. The following section will address this issue.

Misconceptions of Cost-Impact Analysis

One of the most serious misconceptions about cost-impact analysis is that it is merely a subterfuge for seeking to conduct education on a "least-cost" basis. This is a complete misunderstanding of the notion of efficiency. To an economist efficiency means the achievement of a given objective with the least cost of the maximization of a given objective with a given cost. Efficiency combines both input and output.

A second misconception is that impact is measured only in dollar terms, and that this is a form of crass materialism. Cost-impact analysis recognizes that there are noneconomic benefits which should be taken into account. Such noneconomic impact variables include voting behavior, job satisfaction, cultural values, etc. However, it is essential that these objectives should be established on the basis of impact goals which are both measurable and weighted in terms of importance.

A third criticism usually advanced against cost-impact analysis is that there are some things which are not quantifiable. Presumably, this means that there is no way in which one can determine whether or not a given objective has been attained. If this is so, what justification exists to continue expenditures for objectives which cannot be quantified? Why make the assumption that nonquantifiable objectives are automatically good? Although certain objectives may be difficult to quantify, every

effort should be made to develop "inferential" (or proxy) indexes. Psychologists can be of great assistance not only in the development of such indexes, but also in the creation of the necessary instruments designed to compute them.

A fourth criticism frequently mentioned is that cost-impact techniques have not been fully developed and, therefore, should not be applied. The first part of the statement is correct, but the conclusion does not follow. The fact is that once a decision is made to spend more on, say, Occupational Education, an implicit decision has been made that the benefits exceed the costs. Therefore, the issue is not whether cost-impact analysis should be applied to Occupational Education. It is being done every day when an educational manager decides to spend a dollar on Occupational Education rather than on another type of education. The only question is whether the Occupational Education manager should be required to state explicitly the manner in which he arrived at the decision. When the process of decision-making is made explicit, then others have an opportunity to judge the correctness of the process. It is only in this way that better decisions can be made on the allocation of limited resources for educational objectives. The rejection of an explicit cost-impact analysis simply means the refusal to expose oneself to an evaluation of a decision-making process.

Finally, it is sometimes argued that cost-impact analysis tends to ignore political considerations. Although the analysis ignores the political aspects of a program it does not necessarily follow that the decision-maker should ignore politics. This type of analysis, however, will tend

to reveal the cost of a political decision and may well tend to minimize the role of politics in the decision-making process.

Types of Cost Data for Cost-Impact Analysis

In obtaining cost data for Occupational Education a distinction should be made between determining average costs per program, per class, per student, or per student hour and the marginal (extra, incremental) cost per program, per class, per student, or per student hour. Average costs are computed by dividing total costs by the number of units being used as a measure of output - e.g., per program, per class, per student, or per student hour.

But the average cost per unit being utilized differs from the marginal cost of adding another program, class, student, or student hour primarily because certain costs are fixed regardless of adding additional units. It may be, for example, a teacher's salary remains fixed, regardless of class size, within a certain range of enrollment. Thus, marginal costs are computed by determining the change in total costs divided by the change in the number of units being employed (program, class, student, or student hour).

The decision to determine whether or not to add an additional program, class, student, or student hour should be based, in part, on the marginal cost and not the average cost of the operation to that point.

Therefore, in obtaining cost data for cost-impact analysis it is essential to obtain data on total costs as related to varying units being employed for measurement. In this manner both average costs and marginal costs can be computed.

It is true, of course, that a given school may not have actual operating data on the variation of costs by a particular unit of measurement. For analytical purposes, historical data may yield such variation, or data from many schools can yield the equivalent information. Both approaches may require certain adjustments.

Types of Impact Data

Impact data are both monetary and nonmonetary. Monetary impact data can be based on labor market histories reported by mail questionnaires from graduates. Earnings and employment behavior can be used as proximate measures of monetary impact. However, allowances for variations in the sociodemographic characteristics of the graduates should be made. It is desirable to obtain employment and earnings data for a period of years recognizing the limitations of the "memory" factor and that the graduate's performance in the labor market in a long run might be highly related to his labor market experience and sociodemographic characteristics, rather than to the kind of training received in the relatively distant past.

Nonmonetary impact data include descriptions of citizenship behavior, social behavior and self-concept. The likely influence of intervening experiences between program completion and the time when the impact measure is taken is important and must be treated in the analysis.

Monetary and nonmonetary benefits must be differentially described and weighted, consistent with impact goal specification. Cost-impact analysis is a generic analysis which includes a determination of the

relationship between all costs of education and all impacts of the educational product on society. Cost-benefit analysis, however, treats only impact measures which can be quantified by dollars. Cost-benefit analysis is a less comprehensive measure than cost-impact analysis. In fact, cost-benefit analysis is a part of cost-impact analysis and must be evaluated accordingly. Unless the noneconomic benefits are accounted for in the development of a cost-impact analysis, such information is incomplete and will typically be understated. The crucial criteria are the stated impact goals, which form the basis for weighting and evaluating cost-benefit data.

However, in order to determine whether or not to invest another dollar in Occupational Education the relationship between costs and benefits should be determined, taking into account such factors as time, depreciation, risk and uncertainty. The implementation of a cost-benefit analysis raises certain methodological and conceptual issues. These are discussed below.

Implementation Concerns for a Cost-Benefit Analysis

The increasing trend of public expenditure for education, and in particular on Occupational Education, necessitates the evaluation of the efficiency of the different educational processes. Since there is a limited amount of available resources, they should be allocated so as to obtain the highest productivity from them. The choice in education is not whether to invest, but how much to invest. A study of the relationship between benefits and costs is concerned with the determination of

the optimum allocation of resources between occupational and academic education in secondary and postsecondary education. For this purpose, measurement is needed of both costs and benefits. As stated previously, costs by themselves can neither be taken as an indication of efficiency, nor can benefits be evaluated without taking account of costs.

As indicated earlier, the cost of available resources is defined as the welfare or benefits foregone in receiving or providing education. But these foregone costs should be considered on three levels: the cost to the individual, the cost to the community, and the cost to society; and each of these concepts of costs may be different. For example, the cost of education to the individual includes not only his direct costs, but also his foregone earnings by continuing in education; and the cost to the community includes both the construction and maintenance costs of a school. Social costs will include both of these factors. However, there are costs which cannot always be measured in monetary terms. Unless some method of quantifying these can be found, it will not be possible to measure the true and complete cost of education.

The measurement of benefits is relatively straightforward. But education produces intangible benefits such as a possible reduction in crime and delinquency, an improvement in employment opportunities and a potentially faster rate of economic growth. These benefits are defined as the welfare gained as a result of education. There is again the problem of quantifying social benefits, and also the conceptual problem of defining all the benefits to be considered.

The Appropriate Criterion for the Optimum Allocation of Funds

Given the total amount of resources available for public expenditures on education, it is relevant to determine the optimum allocation of expenditure between occupational and academic education in order to maximize the total benefits. If two alternative programs were mutually exclusive, the average cost of each would need to be compared with the average benefit, in order to reach such a decision. However, if the two programs are not mutually exclusive, measurement of average cost and average benefit will not suffice. In this case the optimum amount of public expenditure for occupational and academic education will be an allocation of funds such that the marginal benefit-marginal cost ratio for Occupational Education is equal to the marginal benefit-marginal cost ration for academic education; or, in other words, where the additional benefit from an additional dollar spent on the two educational processes is equal.

Although the theoretical criterion for the optimum allocation of expenditure is clearcut, there are two major difficulties when considering investment in education. First, it may be difficult to derive an accurate measurement of benefits or costs, and secondly, the benefits and costs are more general than those measured by simple economic indicies.

There are three main steps in a cost-benefit analysis. First, all costs and benefits must be identified. Secondly, the list of benefits and costs should be expressed in monetary terms, in order to give an estimate of the net benefits of the project. Finally, a comparison must

be made of the stream of annual benefits and the cost of the project.

It bears repeating that cost-benefit analysis must be examined in the light of the relationship between stated impact goals for Occupational Education and nonmonetary impact information. An important definitional distinction is hereby reemphasized. Cost-impact information describes all impact information in terms of specified impact goals, while cost-benefit information is limited to a comparison which includes only benefits that can be quantified by dollars.

Conceptual Problems in the Application of Cost-Benefit Analysis

Although cost-benefit analysis does appear to be a straightforward procedure, it does have several conceptual problems. One of these is that monetary and accounting costs do not necessarily reflect the real opportunity costs to society. Second, although it is justifiable to compare different types of private goods and services, it does not follow that it is meaningful to compare a private good with a social good such as education. The two are fundamentally not comparable.

Third, problems arise in considering foregone earnings as an opportunity cost to society. If a substantial number of students move into the labor market, the increase in labor supply will reduce the marginal productivity of labor and hence reduce earnings. Therefore, by defining foregone earnings as those returns which would be earned in employment instead of going to school, they may overestimate the true opportunity cost. In other words, in determining the efficiency of an

investment by considering the costs or benefits incurred by society without it, one should take into account the fact that the investment may itself alter the economic structure.

Fourth, for an individual, the most explicit economic benefit of education is reflected in his earnings and employment. But they are affected by his native ability, motivation and other personal characteristics. To arrive at a useful estimate of benefit due solely to education, the effect of all other factors should be held constant. Consideration should also be given to the fact that earnings depend not only on the education and personality of the individual, but also on the supply of and demand for the type of skill for which he is trained.

Fifth, cost-benefit analysis in education has to be conducted on the basis of observed data, unlike the analysis of other public investment projects which make use of engineering data. Hence the results of applying such an analytic procedure on observed data may be very difficult to interpret. For example, if the analysis shows that costs are greater than benefits, it may reflect the fact that a given educational program is carried on inefficiently, instead of the fact that the level of expenditure on the type of education in question is not economically worthwhile.

The Discount Rate

Assuming that all costs and benefits have been measured satisfactorily, the next step is to account for the fact that different investment

alternatives are likely to have different time profiles of their cost and benefit flows. For comparability, future costs and benefits are reduced to their "present value" by discounting at a given interest rate. The purpose of discounting is to attach relative weights to these cost and benefit time profiles in order to account for the productivity of investment, social or private time preference, and risk.

Discounting is theoretically justified for a number of reasons. The first is that the interest rate used in discounting represents the opportunity cost of investment funds; that is invested wealth usually earns a positive rate of interest. Thus, "Y" dollars invested today will yield "Y" + "X" dollars at some time in the future due to the productivity of the investment, and the present value of "Y" + "X" dollars will be "Y" dollars when discounted at the appropriate rate. Secondly, future income is valued less than present income. People have a positive time preference and dislike postponing consumption. Third, risk reduces the value of any given stream of future benefits.

Economic theory and empirical research do not, however, give an answer to the question of choice of rate of interest. There is no uniquely, correct interest rate, and the final choice must essentially be based on value judgment. Empirical rates of interest observed in the market place appear to vary between four percent and ten percent and a variety have been used in cost-benefit analyses. Yet the choice is important, for the interest rate used in discounting plays a critical role in deciding between alternative investments. A low rate will discriminate in favor of those investments whose benefits accrue in the distant future as

against those whose benefits accrue in the near future.

Not only is there a variety of interest rates to choose from at any one time, but also the use of a unique rate over the entire period may be conceptually incorrect. External circumstances may change, the federal governmnet may manipulate interest rates, and so investment opportunities may be altered. Investment in education may itself affect the future rate of return, for example, by altering the income distribution.

Investment Criteria

There is a variety of investment criteria which are available to the education decision-maker when he is faced with the question of whether to invest an additional dollar in Occupational Education or academic education. It is not the purpose here to explore these criteria or the conditions under which any particular one should be employed. It is sufficient to indicate that the most appropriate, from society's point of view, is to discount the future flow of benefits and the future flow of costs to the present for each type of investment. That investment is to be preferred which produces the maximum return of benefits after the deduction of costs. This approach is very similar to an income statement of a firm which determines its profits after deducting costs from revenues.

Data Needs and Problems

Attention is now directed toward the requirements and ideal form of the data. Fundamental reliance is generally placed on the verification

and measurement of money benefits and costs, although with the realization that such a money index is not necessarily the most appropriate index. Each of the cost elements is considered in turn for social and private costs, and measured for total, average, and marginal costs. As stated earlier, cost-benefit analysis is fundamentally concerned with the efficient allocation of resources, so in this respect the main concern of the analysis is with marginal costs.

Current costs are generally quite straightforward to measure. However, there are serious problems involved in measuring capital costs to education. The physical plant of the school usually has an economic life longer than the period of training for any given educational cohort, and its services are not easily valued in market terms. In order to estimate the rate of capital use, account must be taken of the imputed rent or return on the capital investment, and of depreciation to the capital stock.

A further conceptual problem arises when two or more programs share costs jointly. For example, the same school building may be shared by students following different curricula. In this case the marginal costs and marginal benefits should be assessed independently of joint costs, or, in other words, joint costs should not be distributed. It is only really a practical problem when measurement of average cost is required.

There are only two basic differences between private and social costs. When considering private costs, none of the current or capital

costs incurred by the school system needs to be included. The other difference lies in the treatment of some items such as earnings, which should be net of income tax and other types of taxes for private cost, and gross for social costs.

Analysis of Data

Even when the data requirements can be accurately specified there are some limitations because of the form and availability of data. For the purpose of deciding the allocation of resources between Occupational and nonoccupational education only social costs and monetary social benefits should be considered.

(1) Costs - Costs can be evaluated by statistical methods to explain the technical relationships between costs and those factors affecting the nature of costs, such as the number of students, class size, teachers' salaries, and the nature of the school building. One can utilize time-series or cross-section data.

The aim is to measure and compare the marginal social costs of the two curricula, Occupational and nonoccupational education, and to test whether there are significant differences between them.

(2) Benefits - It is generally agreed that in conceptual terms, benefits are more difficult to measure than costs. It is assumed that money earnings and the percent of time employed out of total time which could be devoted to civilian labor force participation are appropriate indices to measure the social and private benefits of education. Data

on employment and earnings are based on the labor market histories for any particular period following graduation, excluding those who continued into college.

As with costs, independent variables can be introduced into the model, each of which would have an impact upon earnings and employment. The object of this is to exclude variations in certain characteristics such as IQ (which can represent intelligence), city of graduation (which can represent the different industrial structures, price levels and other urban factors), father's education (which can represent social background), race and sex, into the comparison between the two educational cu-icula. It should be noted that there may be interdependence among the independent variables which may obscure the true nature of the empirical relationships.

Occupational Education as an Investment

Given the qualifications to cost-benefit information described earlier, the estimated cost and benefit functions permit an economic comparison between Occupational Education and nonoccupational education graduates in terms of their relative investment value. The purpose of this section is to demonstrate broadly the application of the methodology.

The difference between Occupational Education and nonoccupational education graduates can be calculated (in constant dollars) for the marginal social costs and benefits. Then the discounted marginal benefits and discounted marginal costs for each investment can be computed, using discount rates of, say, six percent and ten percent in order to cover a range of possibilities.

In conducting this type of analysis, it is assumed that the future or present will be identical to the past. It is also assumed that the subsamples of Occupational Education and nonoccupational education graduates are identical in every respect; that neither of the two subsets of graduates intend to go to college; and, finally, that monetary benefits are all that matter.

As indicated previously the excess of discounted benefits over discounted costs for each investment is the basis for the decision. One can also take account of the nonmonetary benefits and costs and compare them with the dollar returns on the investments and make a subjective judgment about the alternative investments.

Implications and Conclusions

If cost-benefit analysis is to be performed, educational institutions must begin keeping adequate cost records as well as other information relating to the production of education. This requires the maintenance of historical data in consistent and meaningful classifications. These data must be kept not only at the school level, but also at the curriculum program level, as well as the impact goal and product objective level.

It cannot be stated too frequently that a cost-benefit ratio is a single number that describes the comparative value of Occupational Education to other educational alternatives. That number does not describe nonmonetary outcomes nor does it relate to noneconomic impact goals. Nonmonetary information must be considered in passing judgment on any social institution, including Occupational Education, and either can be separately

described or "added into" the single number description.

Existing Analytical Information

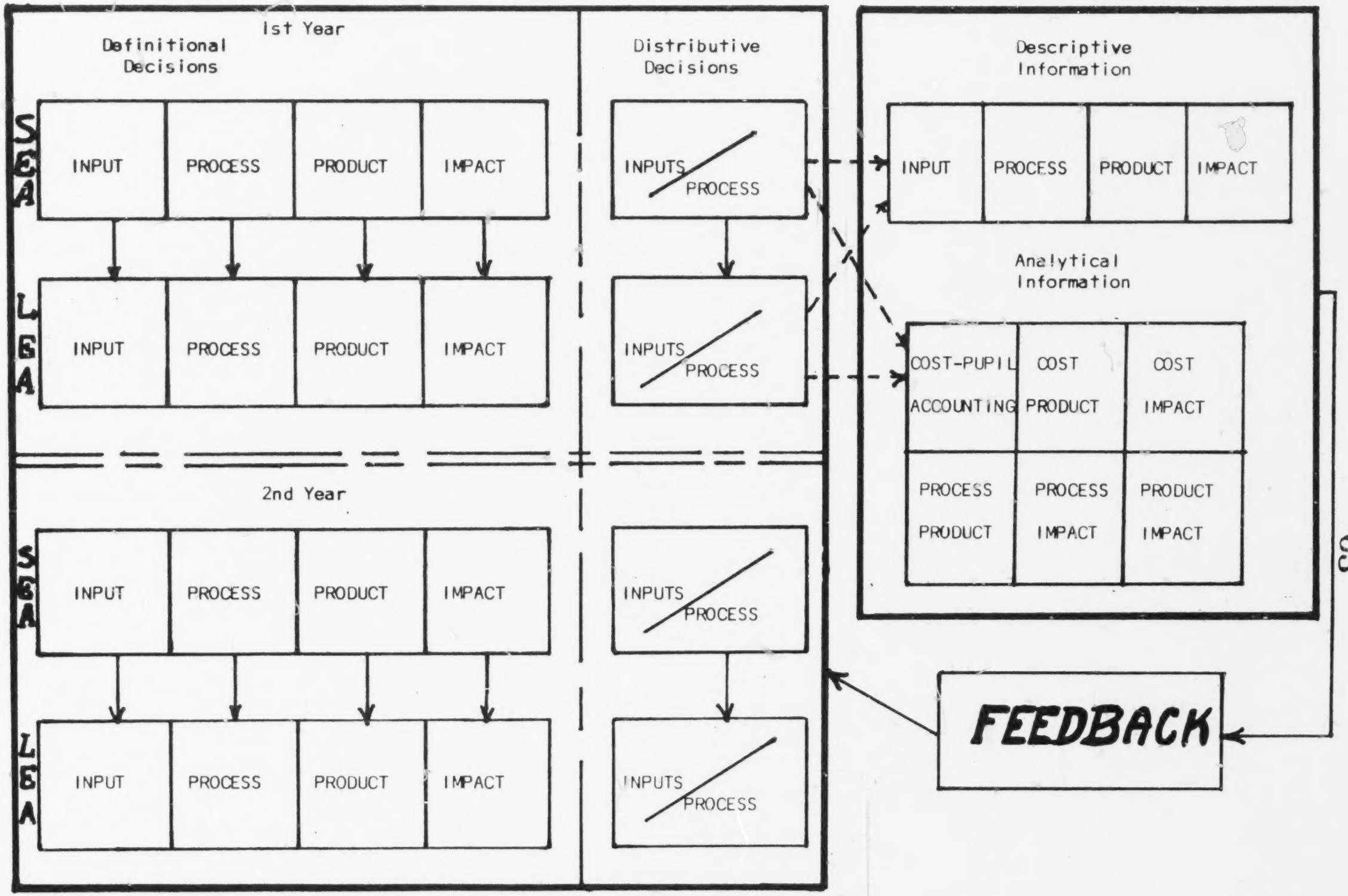
With the exception of a description of pupil enrollment by occupational program, there is no analytical information available as described in this publication in Massachusetts.

Summary

The purpose of the information system is to feed back information into the decision-making process. The regular feedback of such information into the decision-making process not only provides a basis for resource allocation, program modification and accountability, but offers an expanding knowledge base designed to improve the decision-making process. In the absence of such information, management can be little more than an intuitive experience. Figure 5 displays the feedback relationship between the information system and the decision-making process.

Figure 5

FEEDBACK WITHIN THE STATE AND LOCAL
INTEGRATED MANAGEMENT AND INFORMATION SYSTEM



Frequently, information systems are developed as sort of a "smoke screen", whose real purpose is to justify the on-going program. Such efforts are typically unrelated to the institutions they seek to serve in any meaningful way. On the other hand, the Management Information System for Occupational Education developed in this publication cannot be dismissed as a justification data system. It is concerned as a support tool to a rational management process at all levels within the management hierarchy. The total system requires that all managers must be held accountable for outcomes as described by the system. If the rational management process and the supportive information system are concurrently developed and if managers must account for their performance in terms of "the system", the Management Information System for Occupational Education will not be "excess baggage."

All this is consistent with the legal structure of education and provides for locally selected goals, objectives, process elements and inputs within state constraints, and it therefore does not seem to threaten the democratic underpinnings of education in Massachusetts. It merely seeks to provide a support service so that educational managers can systematically evaluate their collective experience and thereby improve upon their performance. Improved performance by the managers of Occupational Education should provide for improved Occupational Education services to the youth of Massachusetts.

Chapter Four

The Nature of the Information System for Occupational Education

The nature of a management information system for an enterprise as complex as Occupational Education in Massachusetts must be comprehensive in scope and yet integrated in such a way that it is useful at all levels in the management hierarchy. At different points in time, role incumbents of all levels of the hierarchical management structure will require unique arrays of information. The system must be flexibly organized in such a manner that it can accommodate a variety of requests for discreet information within a totality of data. For example, the information needs of a local school committee and the legislature in the area of school finance might have many common elements and, at the same time, many distinct dimensions. In fact, the nature of the information will, in large part, determine its usefulness in supporting a rational management process for Occupational Education. Unless educational managers can obtain the kinds of information they require, at the time they request it, and in such a way that the quality of the information is indicated, it is not likely that such information will play an important part in the management process.

In order to understand the full scope, power and flexibility of the Management Information System for Occupational Education, it is

helpful to examine the information system by the dimensions in which its data will be stored or arrayed. Such a description of the dimensionality of the information system provides a picture of the flexibility of the system as a vital and necessary tool for rational management.

System Dimensionality

The dimensionality of any data storage system consists of the subscripts needed to locate precisely every element of information contained in the system. A three dimensional system might be described as X_{ijk} where X stands for the individual elements of data and i, j, and k define the three dimensions of the system. If i possessed three possible values, j four values and k six values, ther the three dimensional system described by X_{ijk} would contain 72 individual elements of data (3X4X6). To illustrate how this is to be used to describe an information system, the three dimensional system defined by i=3; j=4; and k=6 may be the quarterly sales records of six insurance men for the three types of insurance sold by their company during fiscal 72. The i-dimensions are life, term and automobile insurance. The j-dimensions are the four quarters and the k-dimensions define each salesman. If John was the second salesman, then his sales for the first quarter for automobile insurance would be shown by X_{312} would contain the number $22,000.

In the description of the proposed information system the X_{ijk} concept will be used. The definition of the subscripts needed to store

and retrieve data in the system will, in fact, define the dimensionality of the proposed system. The following paragraphs will develop several of the most outstanding dimensions:

Structural Components

The first dimension to be specified is the relationship between the individual piece of data and the elements of the IPPI conceptual structure for Occupational Education stipulated in Chapter One. For example, it will be specified if the information is input information, process information (structural or organizational), product information or impact information. These will all be classified as definitional data while analytical data will be specified as cost-pupil accounting information, process-product information, product-impact information, process-impact information, cost-product information and cost-impact information. This information might change by these dimensions over time and this problem is treated below in connectors and linkages.

Organizational Level

Perhaps the easiest way of describing the decision-makers involved in the instructional setting is to describe them in terms of organizational units. Usually there is a organizational chart which identified different levels of authority and also identifies the different units and their relationships. Figure 3 shown earlier identifies the principal organizational levels in the Commonwealth of Massachusetts for Occupational Education. These organizational levels serve to define the potential

sources from which data can be collected. Hence, these organizational units form an important dimension of the information system as it is necessary to know at what location in the organization the data was gathered. Therefore, if the ages of all teachers were collected, it is essential to know that the figures represent ages of teachers as opposed to students.

Connectors

Within any system there are a series of relationships that show ways of connecting particular subsets of data together. This set of connections form the third dimension of the system. For example, students are nested within a teacher's class, teachers are nested within a principal's school, principals are nested within a regional subdivision of schools, schools are nested within a state. These nesting effects are important data connections. If, for instance, a series of questionnaires were sent out to teachers in the state of Massachusetts and a parallel set of questionnaires were sent out to a subsample of students in the state of Massachusetts, and if an analysis about teacher-student relationships were to be made, students of particular teachers would have to be identifiable. There would have to be connecting links between those students responding on the questionnaire and their teachers responding on a different questionnaire. This is what is meant by connectors.

Within Occupational Education there exist several connectors. One connector, for instance, is a particular school and those teachers working within it. Another connector might be an advisory board in automobile

mechanics and nested within this advisory board are those teachers teaching that subdivision and for each teacher those students studying that aspect of automobile mechanics. Sets of nestors are needed to identify which data can be accumulated or broken out in terms of individual analysis.

Linkages

Even though data can be traced to a specific organizational level and to a specific person in that level, there exists a need for an additional dimension to display relationships. The following example best illustrates the need for this dimension: When a student leaves the first level of a program his completion level is output, but the following year this completion level becomes the entry level for the next program phase and becomes input. There exists a need to code this data such that this cause-effect relationship can be traced. The longitudinal need to trace cause-effect relationships will probably be the most frequently occurring need for data linkages. However, other examples that are not time-centered can be pointed out. Assume a student has an exceptional shop performance record, the question becomes what were the program components contributing to this record. Perhaps the student received both related and shop instruction which could contribute to the measured performance. Linkages are needed to associate shop work with related instruction; hence, linkages showing relationships of data to individuals and to previous data must be established.

Types of Variables

A fifth dimension will be described within the coding system as

one built basically on the nature of the variable being coded. This information will describe "at what level the variable was fixed" and "at what level it is manipulatable". Frequently, variables are fixed at all levels, and often they are determined at higher levels and become constraints at lower levels. This classification tends to describe contraints or "givens" on the decision-making process at specific levels.

Subject Area Identification

A sixth dimension of the instructional system is that of subject of content area. In Occupational Education, the U. S. Office of Education has built from a series of occupational studies a taxonomy of subject areas. Further, specification of these subjects into basic units as is being used at ESCOE* will be included in this dimension. ESCOE identifies the subject area by field or trade, by division, and ultimately by unit and specific objective. These divisions break up the content area into enough units that content specificity is readily available within the coding system.

Impact Goal or Product Objective Identification

All information in the Massachusetts Information System for Occupational Education will be referenced by an impact goal or product objective. This dimension constitutes the seventh dimension of the information system. Since the management structure to which the information system is related and supports is based upon a system of related impact goals and product objectives at both the state and local level, the information within the system must be

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* Evaluation Service Center for Occupational Education, previously described.

classified accordingly. The structure for Occupational Education presented in this publication is conceived such that all local impact goals and product objectives display a straightline relationship to those established at the state level. This dimension allows information to be sliced and analyzed by these goals and objectives on both the state and local level. It provides a fundamental accountability tool.

Observation Instrument Dimension

An eighth dimension of the information system is that of the observation instrument techniques used in gathering the data. When one records a piece of data, it is necessary to know upon what basis this data was generated. Conceivably, the data could be gained from the administration of a specific test, i.e., the Allport-Vernon test of values could provide a particular piece of data information. If this is true, a classification code to tell us which piece of information was extracted from the Allport-Vernon administration and the fact that it was an Allport-Vernon administration is important. A code system must be constructed which will allow identification of the testing instrument and the particular piece of information presented or gained from the testing instrument in terms of the particular piece of data available. Hence, observation instruments should be given code numbers, by class or type of observation instrument.

There are several kinds of observation instruments that seemingly are worthy of note in terms of development of an information system. There exists what are commonly called paper and pencil tests, inventories of pupils, collected nominal data in terms of pupil enrollment, pupil attendance

in class, teacher credentials, performance testing information, attitudinal scaling information, background characteristics data, results of classroom observation, and behavioral range scales. This wide range of testing information would cause one to build a categorical system which identifies both the type of observation technique and the specific instrument used in generating the information being recorded. This can be accomplished by the creation of either a four or five digit identification number which would be uniquely assigned to particular observation instruments and data types.

Time of Observations

The time of observation is another important dimension in the description of an information system, and becomes the ninth dimension. If the information system is to gather data two, three, four, or five times over a five year or three-year period, certainly the order in which that information was obtained on a particular subject or unit is of utmost importance. Repeated measurement tends to identify a search for change and change variables are important to be measured and dealt with in an information system. Therefore, time and circumstances which surround the observation or collection of data is essential. This can be established with the determination of a testing period and time code set-up on possibly a three or four digit basis. Specific test-retest periods could be identified and attached to dates as one way of showing testing times. Another way of showing testing time might be in relation to period of progress.

Method of Observation

The tenth dimension of the information system is a record of how the particular pieces of information have been collected. Within the context of a usable and complex information system it seems likely that three different kinds of observation methods might be used. One kind of observation method is that of the statewide census and for certain aspects of data this is permissible and recommended. Another kind of observation is through a statewide sample chosen on a random basis and stratified over the important dimensions deemed worthy of describing their status in Occupational Education. Sampling basis, however, should be identified and in the case of sampling techniques with projections to statewide samples the ultimately selected sampling proportions should be stated such that weighting systems would be developed. A third identifiable type of observation method is that of the intense case study. This would be used specifically for individual problems or intense follow-up studies. These intense samples should be identifiable within the system and should be kept as part of the basic information system as opposed to being relegated to an outside role as an adjoining explanatory subsample.

Individual or Replication Identification

Within each kind of data collected there are individual subjects upon which the data is gathered. These individual subjects are said to be the replications within a specific frame of information. The eleventh dimension of the system should be devoted to the identification of individual subjects or replications within the data frame.

Potential Other Dimensions

Potentially, there are other dimensions that might enhance this description of the information system. Additional dimensions can be established in terms of kinds of objectives, kinds of units measured (dollars, people, books, etc.) or established in terms of classification systems or types of decisions. At this stage, none of these additional dimensions appear to be of ample importance to merit being built into the system. If any of these or other unthought of dimensions seem to be of importance, then they can be added without altering the system design. At the time of addition of a new dimension it must be recognized that stored data would not necessarily be retrievable under the new dimension but future data would.

Summary

Taken together, the description of the structure and nature of the Management Information System for Occupational Education provides the conceptual framework for a system which is, at the same time, related to and supportive of a stipulated rational process for educational management and sufficiently flexible to accommodate a broad range of uses. By this point in time, the mutual dependence of the rational process for managing Occupational Education and the Management Information System for Occupational Education must be clear. Hopefully, by this time it is obvious that if current management for Occupational Education, or for that matter all education, really wants to manage education rationally, they must support the development of a comprehensive information system as

offered in this publication. The absence of such support can hardly be characterized as enlightened leadership. The tragedy is that most of the elements required for such development are hardly new, they have just never been assembled into a system.

Unfortunately, developers tend to grossly overstate the potential usefulness of a particular endeavor with which they are currently associated. Perhaps this enthusiasm is necessary to the developer's productivity. Frequently, however, a development activity fosters a legion of disciples whose motives are sometimes something other than enthusiasm. What typically happens is that the project under development becomes represented as a panacea or cure to all ills. To protect against this occurring with the substance of this publication, a final chapter is offered which treats this and related issues.

Chapter Five

Necessary Considerations for System Development

If there has been any one ingredient that has hampered educational improvement, it has been the uncontrolled zeal of well-intentioned camp-followers who understand the form but not the substance of developments designed to improve instruction. Bandwagonism may be useful ploy for career development but it is hardly the stuff of which lasting improvement is built. A second major problem to improvement in education is management's inability to support a sustained effort on a basis broad enough to really change an institution's structure. Although many good things do indeed come in small packages, important changes in complex social institutions are very likely to be more complex than an innovation which can be described in a three thousand word journal article. Over-simplified remedies may do something to maintain management's sanity, but it is unlikely that such activity will make a sustained contribution to the improvement of mankind. Both of these conditions will influence the development of the management and information system offered in this monograph.

The purpose of the chapter is really twofold: (1) to examine the likely impact of a rational management process and supportive information system on Occupational Education over time and (2) to stipulate several of the necessary and sufficient conditions required for the development of such a system. Although the focus of this publication is Occupational Education, it should be obvious that the rational management process

and supportive information system stipulated is generalizable to all curricula areas in education.

Some Thoughts About Impact over Time

It is just possible that society cannot handle rationality in the management of its social institutions. There is very little evidence to this point in time that it can. The assumptions of rationality, i.e. all behavior must be consistent with stated and measurable goals, is probably an unattainable goal for even the most select individuals. It might be that the very process of explicitly describing goals such that they represent a consensus and in a way that human beings can be held accountable for their achievement might tear a community apart. To put it simply, the very process of prioritizing goals for any social institution, including education, might trigger such disharmony within a community that the same process might destroy any opportunity to improve the human condition. In fact, it is not even certain that such a process could occur in a nonviolent fashion. It could be that man has not behaved rationally in managing his social institutions because society just cannot cope with the dissonance produced by such a process.

As long as social institutions are operated from vaguely stated generalities as typically found in federal laws, and guidelines and regulations emanating from these laws which never seem to deal with substance (such as those by which most government agencies operate), the question of values never really raises its head. However, the process of stating measurable impact goals (as impact goals are described in this monograph) and further specifying specific behavioral product

objectives, i.e. exactly what students should be able to do at the termination of learning experiences, forces communities to deal with value questions. And it is at the point of implementing societal values into impact goals where the major breakdown might occur. For example, everyone would probably agree that good citizenship is a fairly useful educational goal. However, if one wants to establish a "citizenship" impact goal, such a statement obviously is not good enough. One would have to begin wrestling with the questions of what good citizens do. This becomes particularly crucial in the process of specifying product objectives. For example, is a good citizen one who refuses to pay a telephone tax because he does not want to support a war in Vietnam, or is a good citizen one who prosecutes such behavior?

Another major problem with the implementation of a rational management process and supportive information system is the obvious danger of overstandardizing goals and processes. Given the tendency of centralization in government, which probably results from wealth distribution and technological developments; given the mentality of government agencies, i.e. their regulatory mindset; and given the enormous range of individuality and socioeconomic conditions within a community or state, such a fear is indeed justified. All the anxieties of the so-called bungling bureaucracy could all of a sudden become a way of life. Clearly, an overcentralized and nonresponsive government agency would not serve the varied needs of the people.

It is important to note that the rational management process and supportive information system developed in this publication is proposed for Occupational Education, a narrowly defined social service which

operates off a widely held American value, work and productivity are good. Given the limited scope of the management process and information system, it does not seem likely that the development of such a process for this particular social institution is likely to be disruptive. However, even within an area in which there is such broad agreement there are a number of value questions to which there is not a widely held consensus. For a simple example, there are some conflicting attitudes operating about the goodness of committing youth to a particular occupational area at age 15. These realities cannot be swept under the rug.

A fundamental feature of the rational management process for Occupational Education and the supportive information system developed in this publication is its ability to handle concurrently a wide range of impact goals and product objectives. The sytem is described so that the technology will not standardize social services. This is equally true with both impact goals and product objectives. If managers of Occupational Education at the state level will seek to maintain goals and objectives which are broad enough to accommodate the enormous diversity which exists in the wide range of communities within a state, and if the supportive information system not only describes the degree to which state goals are met but the degree to which local goals and objectives are attained, and if management at all levels recognizes the need for diversity within a structured whole, then it seems reasonable to conclude that ten years from now the implementation of a rational management process and supportive information system might contribute to the improvement of the social institution described as Occupational Education. As a matter of fact, it just might contribute to a more responsive and diverse program of Occupational Education within Massachusetts

than is otherwise attainable. It might be that it is easier to standardize practice in the absence of a comprehensive information system and a rational management process than with one operational. For example, assume state management determines that all students who are to be graduated from approved Occupational Education programs must attend secondary programs for three years, and each school year must be 180 days in length, of which seventy-five percent of the student's time must be spent in either a shop or shop-related experience. (As a matter of fact, this is how Occupational Education has been conducted in Massachusetts for the last forty years). An information system might describe to management that not all students require the same program to attain stated objectives and that some students can succeed in half the time. This would not only release some students from an unnecessary experience, but free enormous resources to reach other students with a valuable social service. Without an information system operating within a rational management structure, there would be no evidence to describe such outcomes, and the decision to abort or maintain a program would continue to be based on limited information and frequently result from a well-intentioned but unquestioned whim of whoever is in power at the moment. There is absolutely no way to challenge this process in behalf of program improvement, short of political manipulation, without contrary information.

The Dr. Jekyll-Mr. Hyde potential of the rational management process and supportive information system, however, is very real. In the wrong hands it can be a tool of oppression, social stagnancy, and even revolution. In the hands of competent and sensitive human beings, however, it has the

potential to provide a knowledge base to improve the delivery of an important social service. The system developed in this publication should be considered as a tool for educational improvement. It will structure and integrate Occupational Education such that all managers on all levels will know what their goals are, and regularly receive information which describes the degree to which these goals are attained. Over time, they will begin to develop information which estimates the extent to which various program or process elements contribute to goal achievement, and at what cost. This system is no panacea. It does not take the place of dedicated and imaginative professionals. It will, however, describe the collective experience of educators such that it can play a more consistent role in educational improvement.

Necessary and Sufficient Conditions for Implementation

Two necessary and sufficient conditions will be stipulated in this section: (1) sustained support; (2) skilled management. A rational management process and supportive information system are really always in the state of development. The rational management process and information system developed in this publication provides the manager with a set of tools so that he can meet his responsibilities more efficiently. Currently educational managers at all levels, including Occupational Education management, are using a very crude set of tools. Decisions are typically made on limited information, there is rarely systematic evidence accumulated about the results of management decisions in Occupational Education, and there is really no process of orchestrating goals and objectives to deliver this vital social service within a state. So that the reader does not get

a mistaken impression at this point in time, Occupational Education is no worse than secondary education, higher education, or most social services in American society. However, development of the services described in this publication will not occur quickly. This is assumed to be so self-evident that it hardly deserves mention. However, it must be pointed out that unless sustained support for the development of a rational management system and supportive information system is maintained over a period of time, it is very unlikely that very much of significance will occur.

Occupational Education is a complex social service. It deals with sensitive and intricate human beings at a delicate and occasionally desperate stage of human development. Further, Occupational Education in Massachusetts is big business. As previously cited, in Massachusetts alone the bill to the citizens is well over one hundred million dollars. It is just too vital and complex a social service to be managed by well-intentioned amateurs. In order to deal with the data which will be a product of the information system, educational managers must be able to understand the psychological measurement process, and the ways in which knowledge is obtained and reported. The basic tools of statistics, research design, and some economic analysis skills are fundamental. Obviously, one cannot expect the same kinds of technical sophistication at all levels of the management hierarchy stipulated earlier in this publication. Certainly, however, every so-called professional manager, i.e. those that get paid, should possess these skills. Unless provisions are made such that managers find it necessary to acquire the skills necessary to use the information, it should be expected that the system will be rejected as a threat to an established management pattern.

Two major dangers of the use of a somewhat sophisticated information system for educational management exist, under-interpretation and over-interpretation. There seems to be a type of manager to whom information is a threat. These managers typically reject any analysis of the results of decisions for which they are responsible, and soon come to characterize such information as "impractical". This so-called intuitive management style, usually based on limited experience, does not perceive the need for an information system. Therefore, they tend to underinterpret, or occasionally ignore, any information which is either complex, inconsistent with their biases and experiences, or both.

Equally dangerous is the information over-interpreter. Frequently, information dealing with psychological measurement is only an approximation, and often deals with averages of groups with broad variation. It is frequently dangerous to apply such data to any one individual. The use of the IQ score in public education during the last fifty years is a perfect example. Typically, educators have used the IQ score in the absence of the concept of range, and generally behaved as if all human capabilities could be described by one number. Such behavior is not any more desirable than that manifested by the information under-interpretor described above.

The management process supported in this publication could be characterized as something of a hypothesis-testing behavior, whereby the educational manager conceives of his role as achieving measurable goals in the light of a descriptive information feedback system. Put another way, the role of an educational manager is to structure organizational elements such that goals are most likely to be attained at the least cost.

The information system reports back to the administrator regularly the degree to which goals have been attained. In view of this information, management then reorganizes or restructures the educational process such that the probability of goal attainment is maximized. In general, professional management focuses on goal attainment while nonprofessional management, as described in this publication, is basically concerned with value identification for impact goal setting. Both professionals and nonprofessionals, of course, are responsible for management decisions, but it must be the role of the professional manager to understand and interpret the outcomes of a sophisticated information system to the lay public.

Finally, it must be emphasized that the rational management process and supportive information system has the potential to standardize the practice of Occupational Education in every community in Massachusetts. On the other hand, it also can provide a knowledge base which has the capability of contributing to a flexible and reponsive educational process which simultaneously meets the broad range of human needs within Massachusetts. The ultimate value of these tools to make better the condition of life is in the hands of those charged with management responsibility.